Demand-and-Supply Imbalance Risk and Long-Term Swap Spreads
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Discussed by Urban Jermann
Contribution

- Tractable model for pricing interest rate swaps
  - leverage constraint, demand shocks and convergence risk
- User demand proxied by Primary Dealer net Treasuries position
  - Negative swap spreads since 2008
    - Swap spread changes sign when net position changes sign
    - Time-series correlation
- After 2008
  - User demand predicts excess returns
  - User demand 50%/35% of innovation variance weekly/annual
Model

Intermediaries

\[
\max_{x_t, o_t} \left\{ E_t \left[ w_{t,t+1} \right] - \frac{\alpha}{2} Var_t \left[ w_{t,t+1} \right] \right\}
\]

s.t. budget constraint

\[
w_{t,t+1} = w_t + x_t r^s_{t+1} + o_t r^o_{t+1}
\]

s.t. leverage constraint

\[
\kappa_x |x_t| + \kappa_o |o_t| \leq w_t
\]

receive-fixed swap spread trade

\[
r^s_{t+1} \equiv r^S_{t+1} - r^T_{t+1} = (s_t - m_t) - \frac{\delta}{1-\delta} (s_{t+1} - s_t)
\]

\[
s_t \equiv y^S_t - y^T_t
\]

\[
m_t \equiv i^S_t - i^T_t
\]

End-user swap demand

\[
d_t = \bar{d} + z^d_t + \gamma s_t
\]

Market clearing

\[
x_t + d_t = 0
\]
Model characterization

FOC for $x_t$, impose market clearing $x_t = -d_t$, assuming $\text{corr} \left( r^s_{t+1}, r^o_{t+1} \right) = 0$ (LTCM?)

$$E_t r^s_{t+1} = -\alpha V_t d_t - \kappa_x \text{sgn} \left( d_t \right) \psi_t$$
$$= (s_t - m_t) - \frac{\delta}{1 - \delta} (E_t s_{t+1} - s_t)$$

$$s_t = (1 - \delta) \left[ (-\alpha) V_t d_t + (-\kappa_x) \text{sgn} \left( d_t \right) \psi_t + m_t \right] + \delta E_t s_{t+1}$$

If $d_t > 0$ (after 2008) and $E (m_t) < \bar{m}^*$ then $E (s_t) < 0$

"End-users receive fixed, dealers pay fixed, compensation lowers fixed rate"
Affine equilibrium

Assume: $d_t > 0$ (after 2008), constraint always binding, shock processes homoscedastic AR(1)

**Theorem 1**

$$s_t = A_0 + A_m \left[ V \right] z_t^m + A_d \left[ V \right] z_t^d + A_w \left[ V \right] z_t^w$$

and

$$\text{Var}_t [r_{t+1}] \equiv V = \left( \frac{\delta}{1 - \delta} \right)^2 \left( A_m^2 \left[ V \right] \sigma_m^2 + A_d^2 \left[ V \right] \sigma_d^2 + A_o^2 \left[ V \right] \sigma_o^2 \right)$$
Example: Only demand shocks

If \( \kappa_x = 0, \ m_t = 0, \ d_t = \bar{d} + z^d_t, \) and \( z^d_{t+1} = \rho_d z^d_t + \epsilon_{t+1} \) then

\[
s_t = \left( -\alpha \right) V \bar{d} + \left( \frac{1 - \delta}{1 - \delta \rho} \right) \left( -\alpha \right) V z^d_t
\]

and

\[
\text{Var}_t [r^s_{t+1}] \equiv V = \left\{ \left( \frac{\delta}{1 - \delta \rho} \right) \left( -\alpha \right) \right\}^2 \sigma^2_d V^2
\]

2 equilibriums: \( V = 0 \) and \( V = 1/ \left\{ \left( \frac{\delta}{1 - \delta \rho} \right) \left( -\alpha \right) \right\}^2 \sigma^2_d > 0 \)
Main model predictions brought to the data

Prop 1.

\[ E(s_t) < 0 \text{ if } d_t > 0 \text{ (after 2008) and } E(m_t) < \bar{m}^* \]

with \( d_t = \text{Primary Dealer UST Net} \)

Prop 2.

\[ E_t(r_{t+1}^s) = -\kappa_x \psi_t - \alpha Vd_t \]

Prop 5.

\[
\begin{bmatrix}
  s_t \\
  d_t
\end{bmatrix} = \begin{bmatrix}
  A_0 \\
  \bar{d} + \gamma A_0
\end{bmatrix} + \begin{bmatrix}
  - & + \\
  + & +
\end{bmatrix} \begin{bmatrix}
  z^d_t \\
  z^w_t
\end{bmatrix}
\]
Comments/Questions

- Why no leverage constraint shocks on $\kappa_x$?
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Exogenous wealth dynamics misses amplification and new entry.
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- Why no leverage constraint shocks on $\kappa_x$?
- Exogenous wealth dynamics misses amplification and new entry
- $s_t =$

  \[ (1 - \delta) \left\{ \begin{array}{l}
  (-\alpha) V_t d_t + (-\kappa_x) sgn (d_t) \psi(\lvert x_t \rvert - w_t) \\
  \text{comp. for risk} \\
  \text{comp. for capital}
  \end{array} \right\} + m_t \]

  + $\delta E_t s_{t+1}$

  \( \text{short rate diff} \)
Connection to USD-EUR CIP deviations

Du, Hebert, Li (2022)

Figure 1: Primary Dealer Treasury Holing, Swap Spreads, and Cross-Currency Basis.
Add CIP trade to the model

- Appendix B1: outside investment is riskless arbitrage, $a_t$

\[
r_{t+1}^a = \tilde{r}_a - \lambda_a a_t \equiv -CIP \text{ basis}_t
\]
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- Appendix B1: outside investment is riskless arbitrage, \( a_t \)

\[
 r_{t+1}^a = \bar{r}_a - \lambda_a a_t \equiv -CIP \ basis_t
\]

- FOC for \( a_t \)

\[
 \psi_t = \max \left\{ 0, \frac{-CIP \ basis_t}{\kappa_a \text{sgn}(a_t)} \right\}
\]
Add CIP trade to the model

- Appendix B1: outside investment is riskless arbitrage, $a_t$

  \[ r_{t+1}^a = \bar{r}_a - \lambda_a a_t \equiv -CIP \ basis_t \]

- FOC for $a_t$

  \[ \psi_t = \max \left\{ 0, \frac{-CIP \ basis_t}{\kappa_a \text{sgn}(a_t)} \right\} \]

- use for predicting returns

  \[ E_t (r_{t+1}^s) = -\kappa_x \psi_t - \alpha Vd_t \]
Swap spread trade before and after 2008

If balance sheet costs were low pre-2008, supply shocks mattered less and returns behaved differently.
Was swap spread trade profitable for dealers?

(! assuming all swaps have 30 year maturity)
Conclusion

- Insightful paper on important topic!
- Next steps (in this area)
  - Quantitative models
  - Better understanding of dealers’ objectives/constraints